

Joint Polar Satellite System

NOAA's Next-Generation Polar Orbiting
Environmental Satellite System



Aviation Initiative

Jeff Weinrich, Science and Technology Corporation (STC)

GLOBAL DATA.
LOCAL WEATHER.



Agenda

- **Aviation Initiative**
- **Users**
- **Demonstration planning**
- **Conclusion/Summary**



Aviation Initiative

- Focus on polar data needs for aviation users.
- Alaska aviation users will be our initial focus.
- Subject areas include clouds, icing, turbulence, Cold Air Aloft (CAA)
- New Volcanic Ash Initiative will work closely with Aviation Initiative due to similar objectives.
- Plan to partner with FAA, NWS, pilots and other users.



NWS Aviation Initiative Users

Alaska Aviation Weather Unit (AAWU)
National Weather Service Forecast Offices
National Weather Service Center Weather Service Units



NWS Alaska Region Overview



National Weather Service Alaska Region Facilities

- ▲ In Anchorage:**
- Alaska Aviation Weather Unit
 - Anchorage Volcanic Ash Advisory Center
 - Anchorage Center Weather Service Unit
 - Weather Forecast Office
 - River Forecast Center

★ Weather Forecast Offices

● Weather Service Offices

T National Tsunami Warning Center

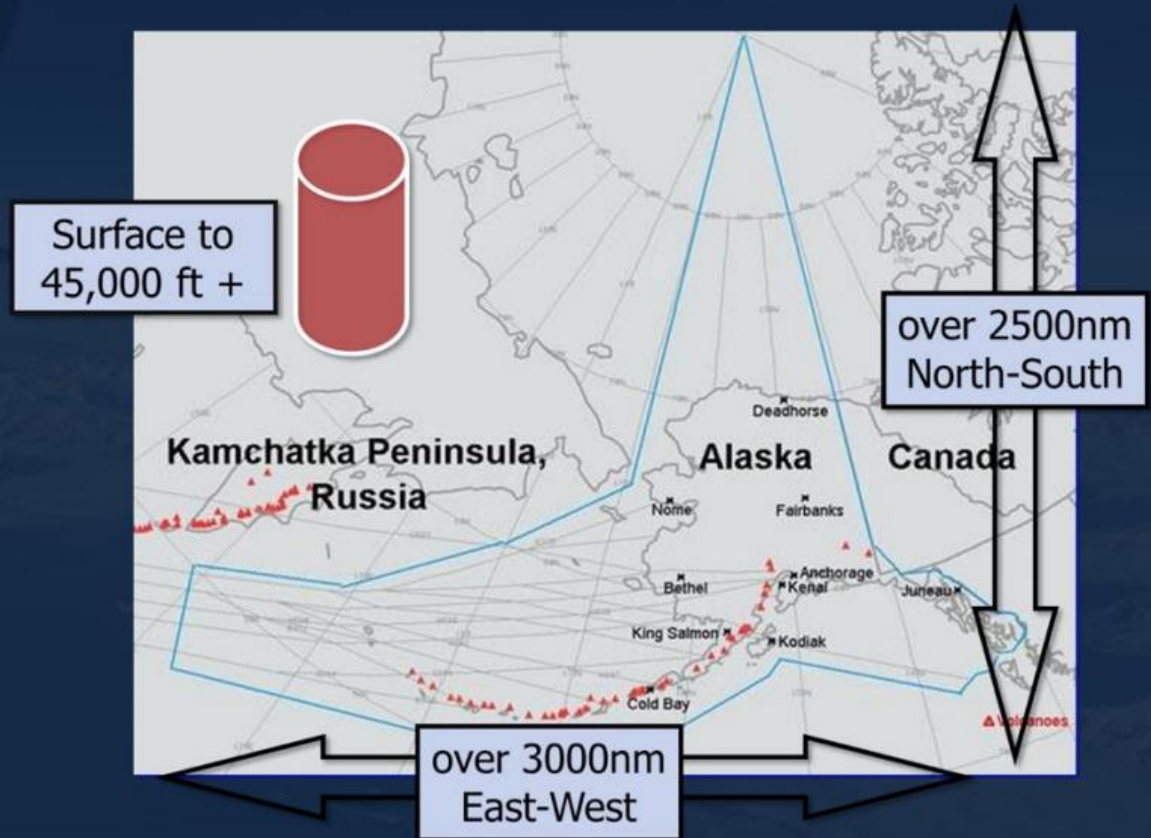


Alaska Aviation Weather Unit (AAWU)



Alaska Aviation Weather Unit (AAWU)

- Forecasts for over 2.4 million sq. miles of airspace
 - Graphics, Area Forecasts, AIRMETs, and SIGMETs
 - Flight Category, Icing, Turbulence, Convection, Surface Analyses, and Volcanic Ash
- Need for a strong internal collaborative forecast process
- Close partnerships with FAA, industry, and formal associations to help guide services



AAWU Forecast Responsibility



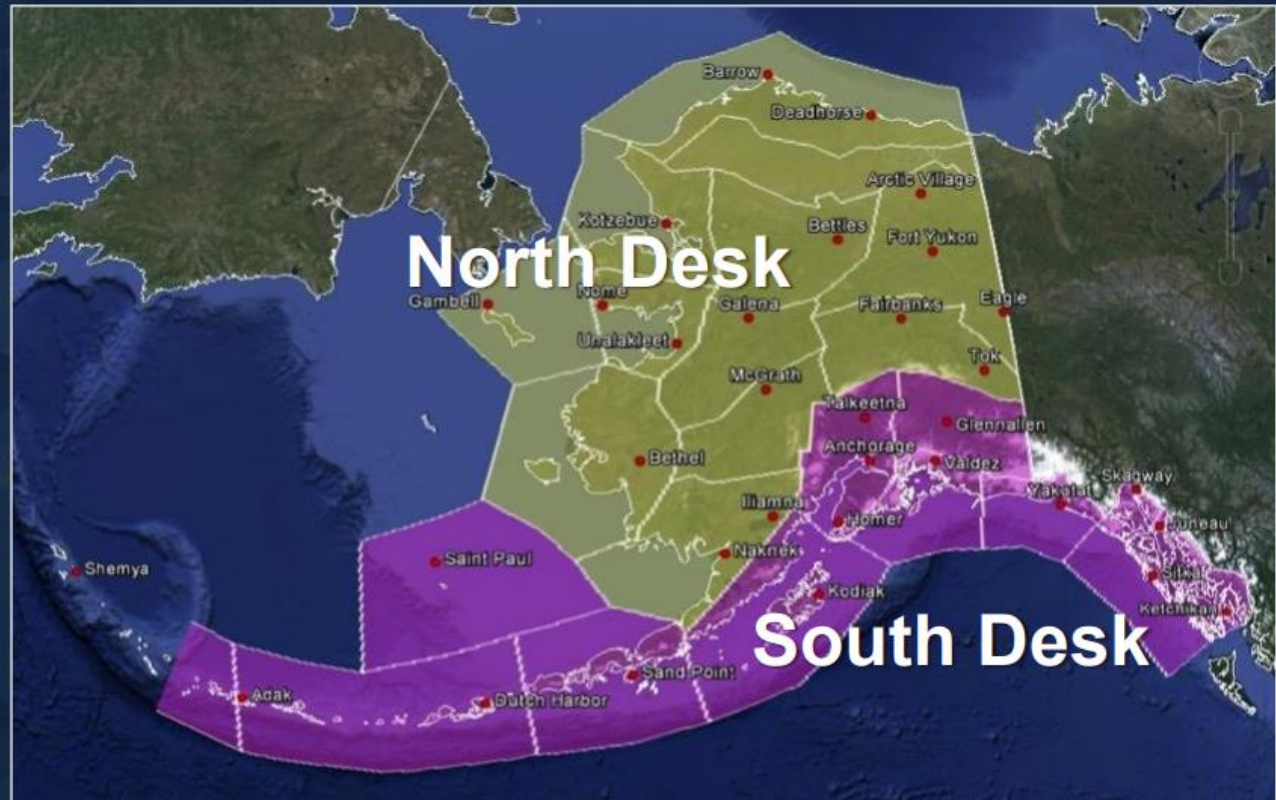
Alaska Aviation Weather Unit (AAWU)

North Desk:

- 12 Area Forecasts
- Freezing Levels
- Icing
- Convection
- Flight Category

South Desk:

- 13 Area Forecasts
- Surface wind
- Low-level Turbulence
- High-level Turbulence
- Surface Analysis



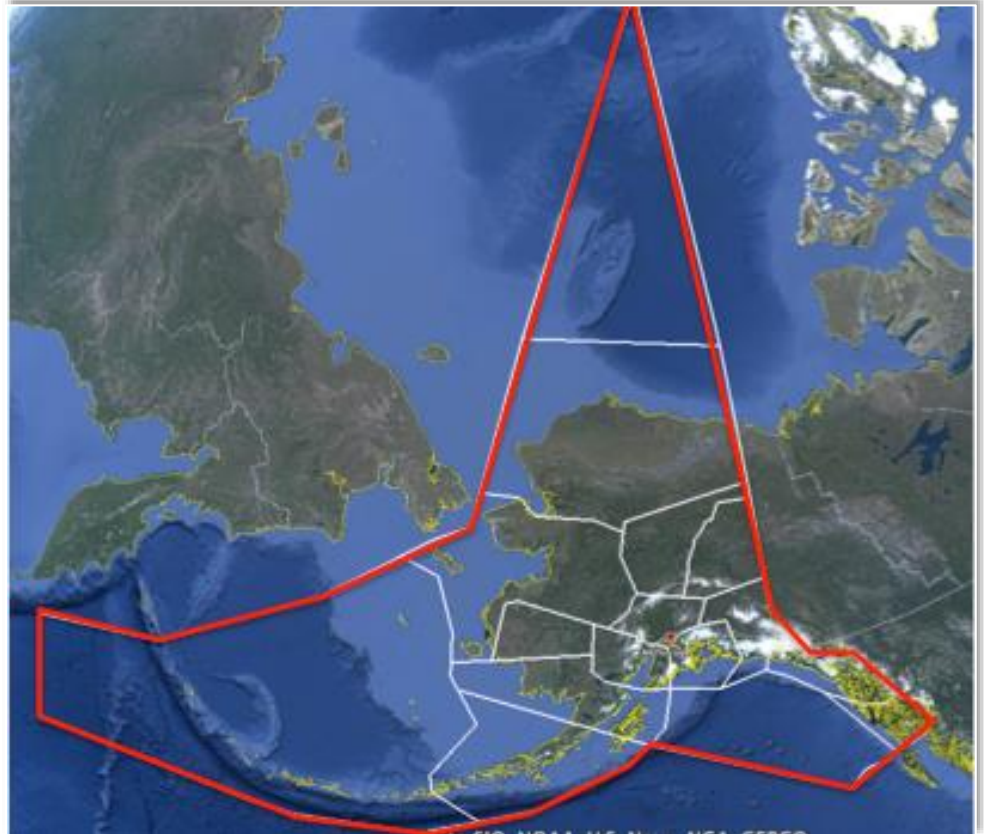
Anchorage Center Weather Service Unit





ZAN CWSU Area of Responsibility

- ZAN Flight Information Region covers 2.4 million square miles
 - = Approximately the area covered by 13 of the 20 Lower 48 CWSUs
- Borders Russian, Japanese, Canadian, and U.S. (Oakland) FIRs



Federal Aviation Administration



Flight Service Duties

- Weather briefing
- Flight Planning
- Emergency Services
- Search And Rescue
- Notices To Airmen (NOTAM)





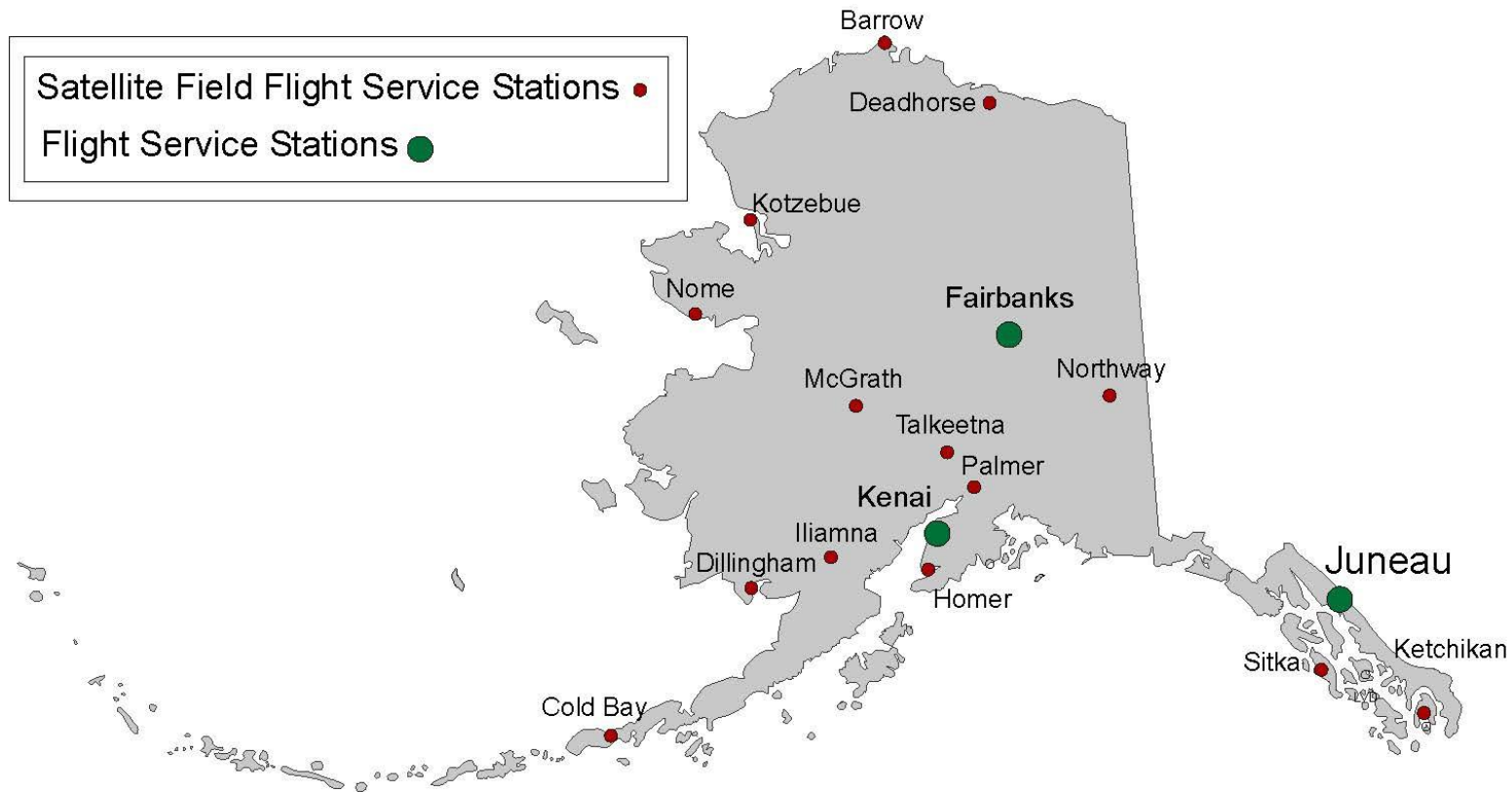
FAA Flight Service Briefing Tools

- Surface Charts
- Weather Prognostic Charts
- Satellite Imagery
- NEXRAD Radar
- Weather Cameras
- Pilot Reports

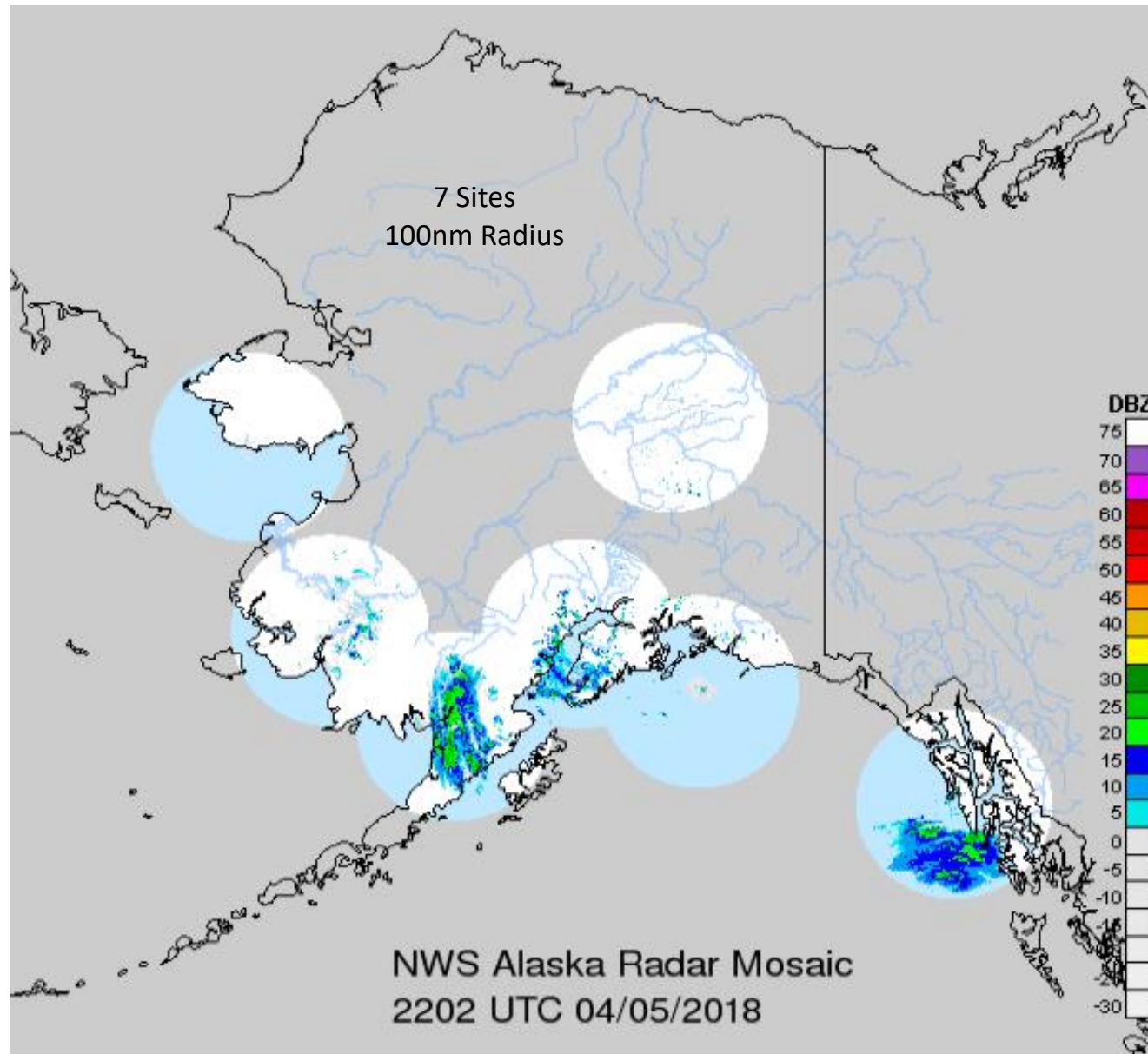
Alaska Flight Service Station Facilities



Alaska Flight Services



NEXRAD Weather Radar





Private Pilots

- Tom George
 - FAA ratings and certificates: Commercial Pilot, Single Engine Land, Single Engine Sea, Multi Engine Land, Instrument Airplane. Also Flight Instructor, Airplane Single Engine
 - Over 4,300 hours flight time, almost exclusively in Alaska. Fly a single engine aircraft, VFR In the past have flown supercubs in off-field operations, today fly a Cessna 185 for business travel, and to collect aerial photography and other data. Mostly operate in Interior, north slope, south central parts of the state.
 - Work for the Aircraft Owners and Pilots Association, a national organization advocating on behalf of pilots and aircraft owners who fly for non-commercial purposes such as private business, government or recreational activities.



Private Pilots

- Adam White
 - Has the following FAA ratings and certifications: Commercial Pilot
 - Single Engine Land
 - Single Engine Sea
 - Multiengine Land
 - Instrument Airplane
 - Flight Instructor
 - Airplane Single Engine
 - Instrument Airplane
 - Mechanic
 - Airframe and Power plant
 - I have 4500+ hours flight time in the past 28 years, 95% of it in Alaska. I primarily fly VFR, single engine, below 10K' and just about every flight involves off-airport operations. I fly floats and wheels in the summer season and skis and wheels in the winter with a Maule M7 and a Cessna 206. While I do fly IFR occasionally, the infrastructure in Alaska doesn't really support IFR operations in remote, off-airport situations. Most of my flights are in the Interior and Northwest Arctic regions of the Alaska. Because I fly in remote, off-airport situations I find it difficult to get an accurate and complete weather picture for flight planning.



NOAA Arctic Test Bed and Proving Ground

Test Bed Specifics

- Purpose
 - Located at NWS Alaska Region HQ, Anchorage. Part of Environmental and Scientific Services Division (ESSD) & the NWS Science and Technology Integration (S&TI) Portfolio
 - Focus NWS Alaska Region development efforts to maximize service delivery effectiveness in Alaska
 - Facilitate and improve (R2O, O2R, and O2O) of new and improved products and services that fulfill current and emerging decision-support requirements
- Capabilities:
 - Integration with NWS forecast systems & data streams, and research data streams
 - Ability to simulate operations with archived data in AWIPS
 - Test generate new products or services in real-time or during simulation
- Synergistic Opportunities
 - Connecting the research community with NWS operations in Alaska
 - Potential to evaluate new datasets directly in operations or in a simulated environment
- Expectations
 - Model and data assimilation improvements to operational models for sea ice forecasting
 - Working with satellite partners to bring new capabilities to the Alaska Sea Ice Program and all of our forecast programs (Marine, Hydro, Aviation, Public, Fire Weather)
 - Evaluate and assimilate new forecast data, methods and procedures into operations

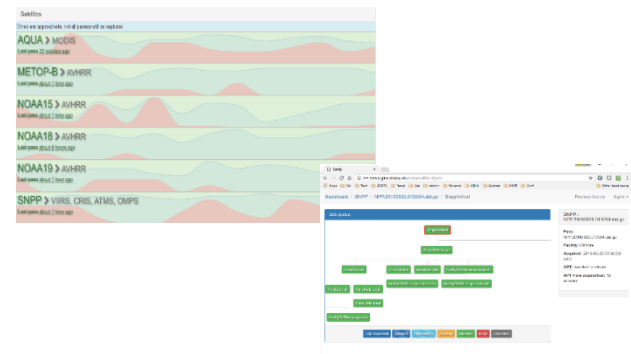
Geographic Information Network of Alaska (GINA)



University of Alaska Fairbanks



NESDIS/FCDAS
Gilmore Creek, AK



The Geographic Information Network of Alaska (GINA) located on the University of Alaska Fairbanks campus receives polar satellite data from several downlink resources via Direct Broadcast. Using redundant systems GINA is able to process and deliver polar satellite data in Near Real Time (NRT) to the National Weather Service and other government agencies in Alaska.

Direct Broadcast satellite processing is made possible by CSPP software provided by CIMSS

<http://cimss.ssec.wisc.edu/cspp/>





Aviation Initiative Goals

- Establish an Alaskan User for the cloud macrophysical (vertical structure) products included in the new CCL formulation.
- Build relationships for perhaps extending into other products where people expressed interest:
- Develop a sense of the utility of JPSS products compared to the current AAWU product suite (IPA, CIP, FIP) from NCAR and FAA. Use feedback to motivate collaboration with those groups.



JPSS Cloud Products Demonstration Motivation

- Alaska region has expressed a renewed interest in JPSS / VIIRS cloud products.
- The recent JPSS Arctic Demo was successful and we plan to leverage off of that experience.

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The Participants

- CIMSS: Deliver CLAVR-x and algs to CSPP-LEO. Support GINA's processing and support cloud height and detection demo.
- CIRA: Work with CIMSS to ensure cloud base and CCL are functioning as planned. Support base and CCL in demo.
- CSPP: Generate JPSS data products from DB data stream.
- GINA: Implement new CSPP-LEO on their DB stream and run POLAR2GRID to inject products into AWIPS.
- Participants just mentioned above: provide feedback
- JPSS Program: Oversight and coordination.
- Arctic Test Bed: Technical Expertise and Feedback Coordination



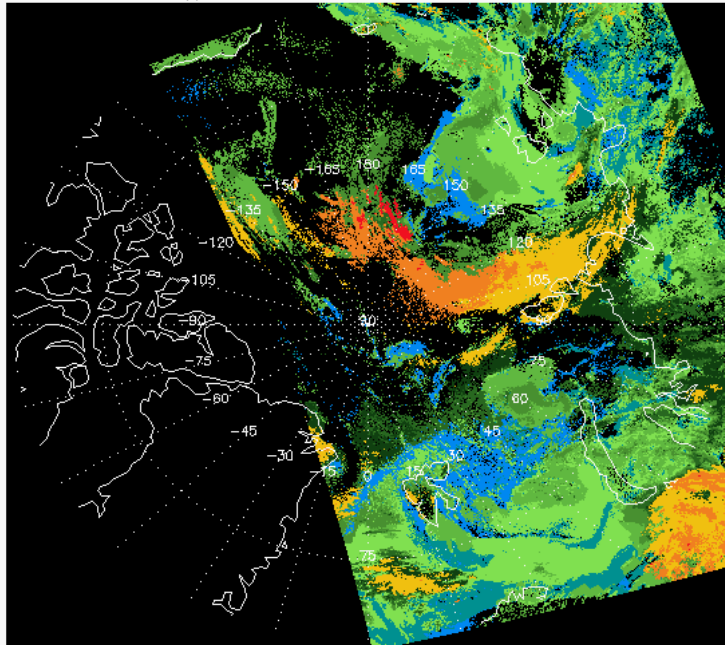
The Products

- Users expressed an interest in the cloud macrophysical products:
 - Cloud top altitude
 - Cloud base altitude
 - Cloud geometrical thickness
 - Cloud cover at flight levels
- Would like to provide these other aviation centric products
 - Supercooled water probability at cloud top
 - Supercooled water probability on flight levels

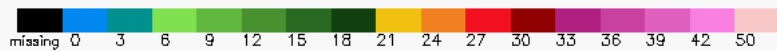
Cloud-top Altitude (kft)

We currently provided this to AWC using global geo data..

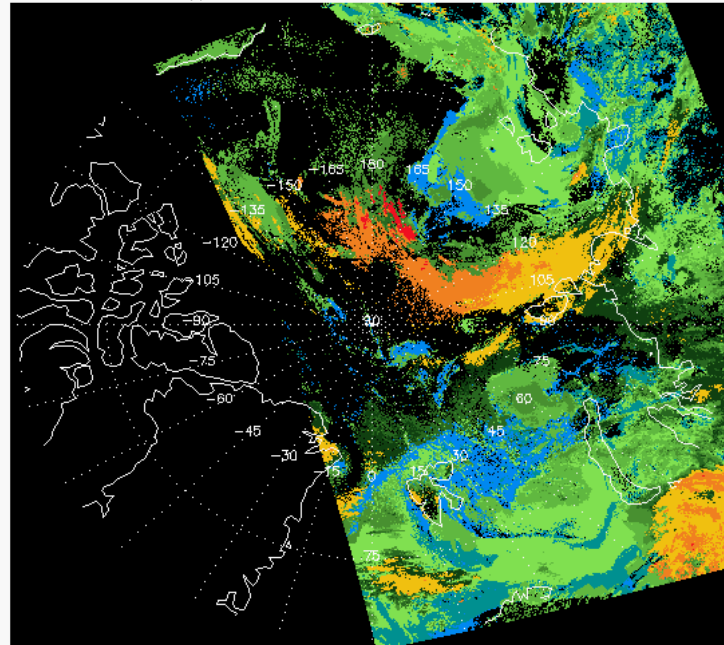
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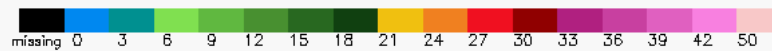
cloud-top altitude (kft)



clavrx_npp_d20180418_t0125099_e0126340_b33534.level2.hdf

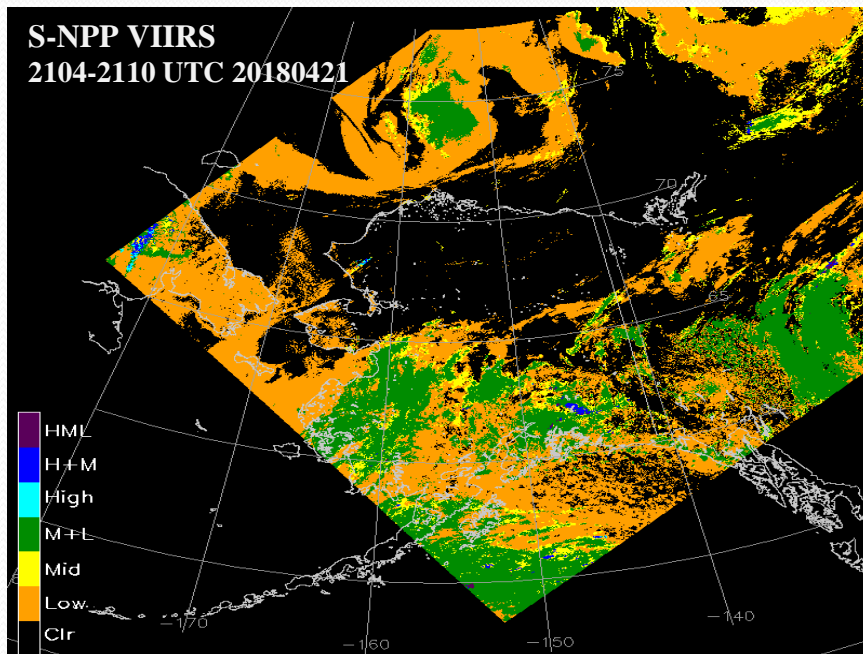


cloud-top altitude (kft)

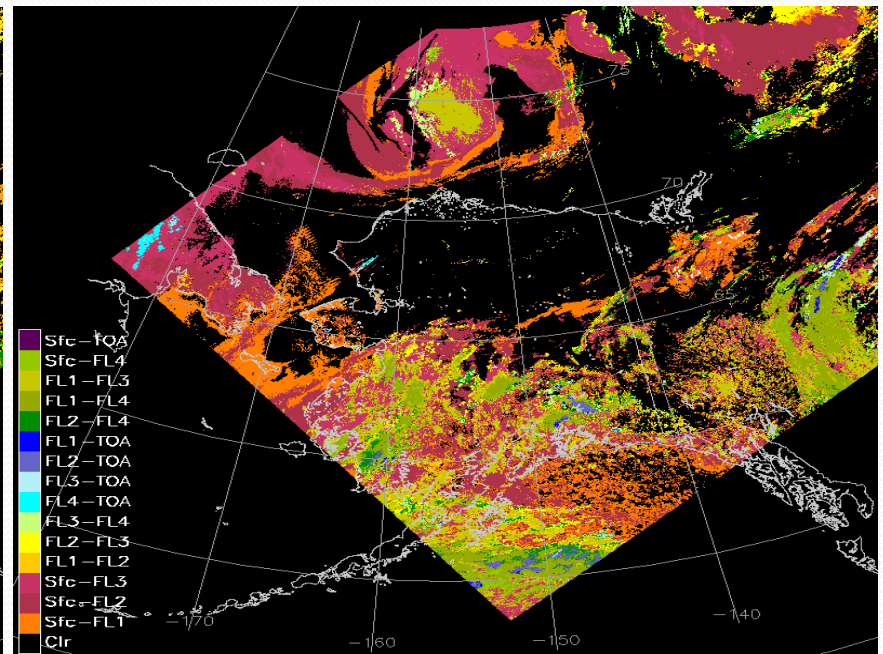


JPSS VIIRS CBH and CCL over Alaska

- Cloud Cover/Layers from S-NPP and NOAA-20 (JPSS-1) over Alaska in near real time
- Flight level-based CCL: Sfc -5 kft - 10 kft - 18 kft - 24 kft – TOA (currently 20 km for CTH)



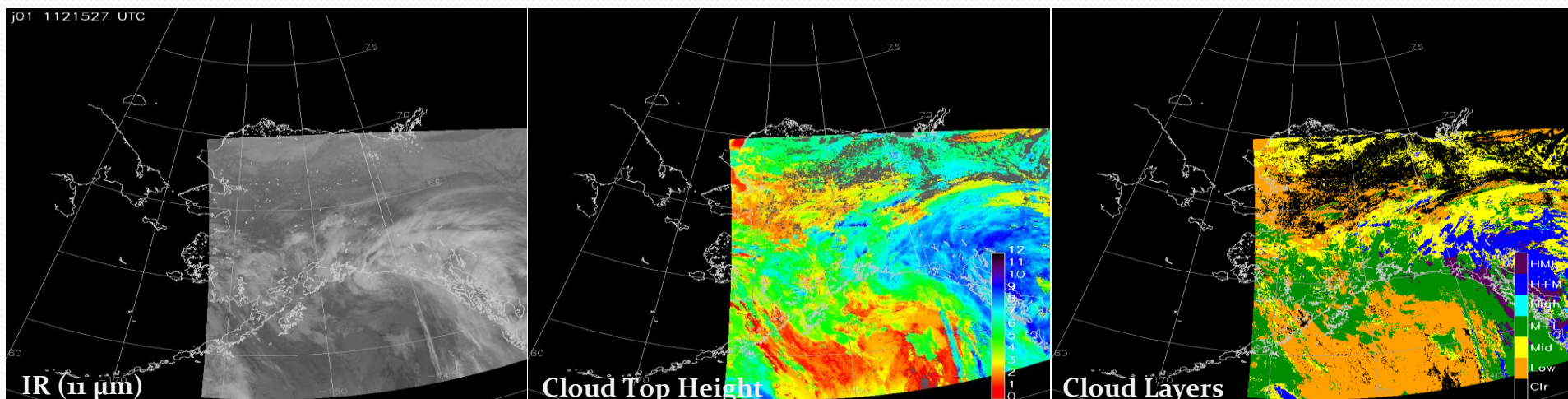
High/Mid/Low CCL
based CCL



Flight level

JPSS VIIRS CBH and CCL over Alaska

- Cloud Cover/Layers from S-NPP and NOAA-20 (JPSS-1) over Alaska in near real time
- Work in progress
 - ✓ Validation against surface-based measurements from the ARM Northern Slope of Alaska (NSA) site: Nighttime performance utilizing VIIRS DNB lunar reflectance
 - ✓ Leveraging research from CIRA's GOES-R Risk Reduction project for multi-layer clouds combining a multi-spectral approach (0.6 & 1.38 μm) and NWP humidity data



Public release in CIRA's Arctic website (http://rammb.cira.colostate.edu/ramsdisk/online/npp_viirs_arctic.asp)





Summary

- An Alaskan Cloud Demo builds on the successful JPSS Arctic Summit.
- First phase will focus on cloud vertical structure for AAWU.
- Will discuss timeframe with JPSS, GINA and AAWU.
- Next steps will be to get JPSS Imagery and products to users.
- How can polar data improve diagnosis and forecast of aviation hazards?



Thank you!

Acknowledge Andy Heidinger, Bonnie Reed and all the users in the initiative

Jeff Weinrich

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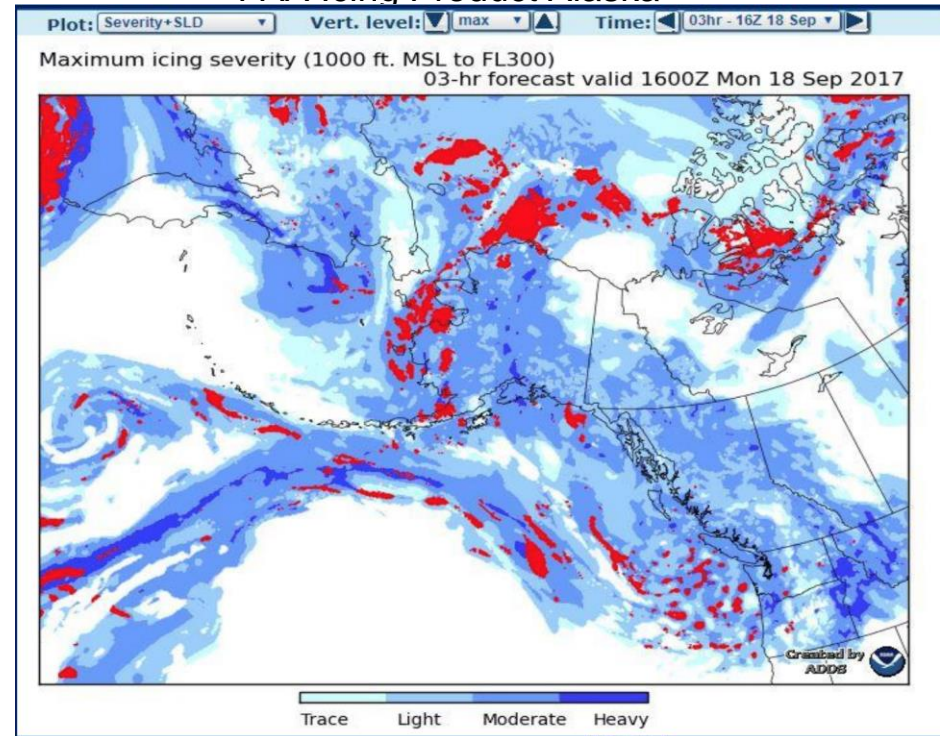
Backup Slides



Role of JPSS Cloud Products in Aviation

- AAWU is evaluating the FAA IPA.
- In CONUS, NCAR's CIP is a dominant source of Icing Information to the NOAA Aviation community.
- Is it relevant to the AAWU?
- CIP uses an NCAR cloud-top temperature but no other satellite products. (Not NOAA or NASA LaRC)
- Should our goal be to integrate with the IPA and the CIP?
- Should JPSS try to present its satellite products in a similar format?

FAA Icing Product Alaska

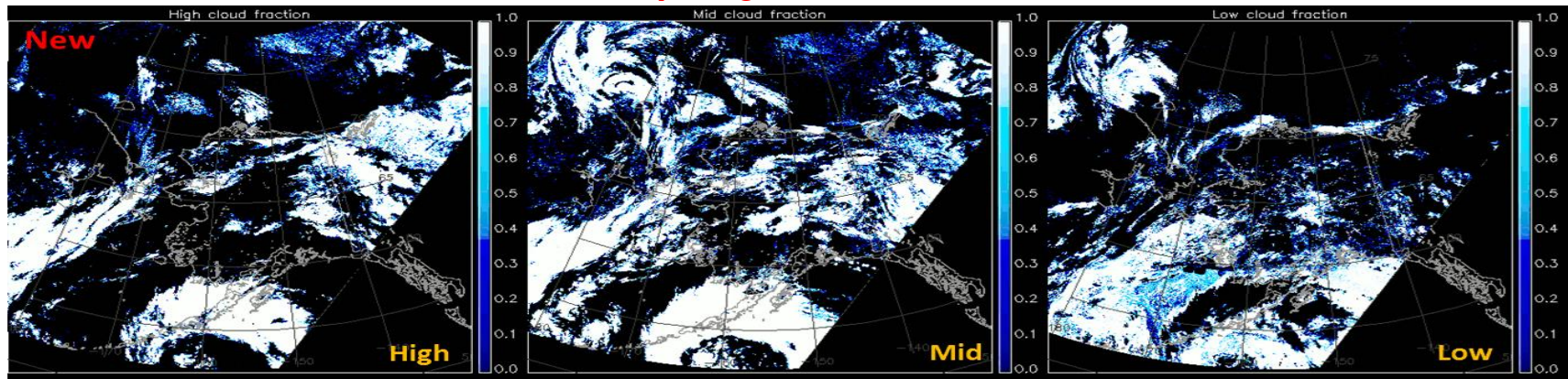


This is a product that is straightforward to make from JPSS suite. Is there value in a JPSS SLD product / image?

JPSS VIIRS CBH and CCL over Alaska

- A statistical Cloud Base Height (CBH) algorithm has been developed by using A-Train satellite data and was intensively evaluated against CloudSat/CALIPSO data
- The algorithm is now operational as part of the NOAA Enterprise Cloud Algorithms
- The CBH information can improve Cloud Cover/Layers products by introducing additional cloud coverage at lower levels of the profile (unobserved via satellite)

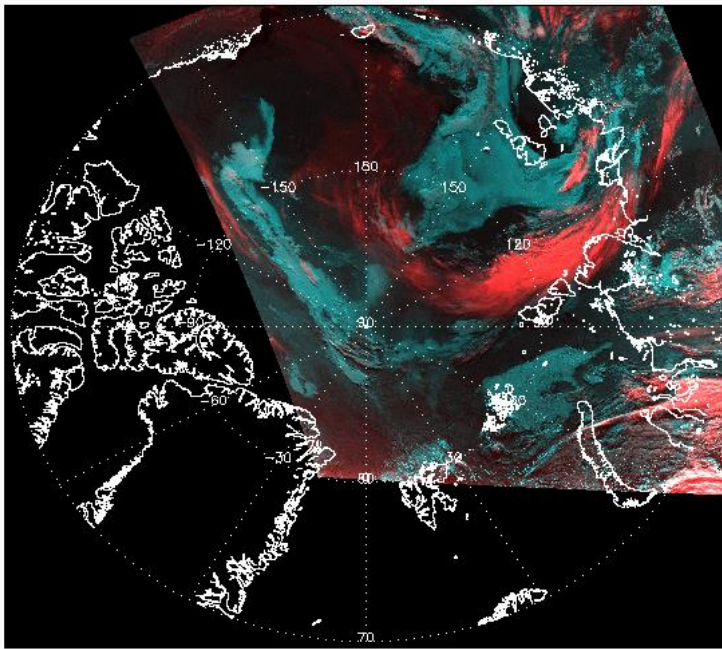
Increases of Middle and Low Cloud Fractions by using the CBH information (S-NPP VIIRS 1355 UTC 2016-02-29 Alaska)



Working on expansion from 3 layers ->5 flight level-based layers at request of NOAT & AWC partners

Impact of NOAA-20 on VIIRS Sampling of the Arctic

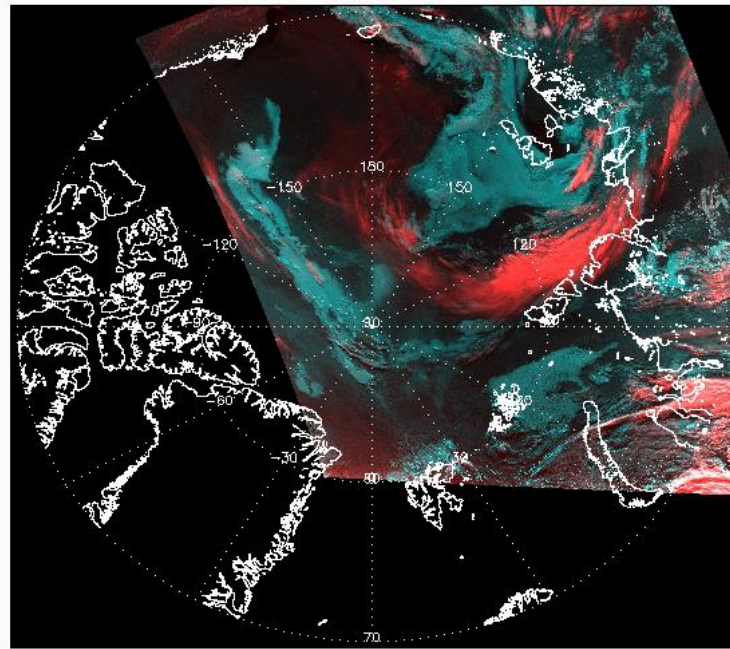
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True Color Image

Red=1.38 μ m, Green = 1.60 μ m, Blue = 1.60 μ m

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True Color Image

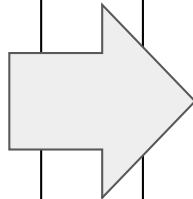
Red=1.38 μ m, Green = 1.60 μ m, Blue = 1.60 μ m

Red = 1.38 micron = cirrus / high cloud
 Cyan = Green + Blue = 1.6 = water phase cloud
 Black = surface ice or open water

Imager Cloud Products Explained

Fundamental Cloud Products (these are products in the JPSS documentation that we have to make and meet spec)

- Cloud Presence
- Cloud Phase
- Cloud Vertical Extent
- Cloud Mass
- Cloud Particle Size



Derived Cloud Products (These are the products based on the fundamental products to estimate products of more meteorological relevance.

- Skycover
- Icing Threat
- Supercooled Water Prob.
- Cloud Cover at Flight Levels
- Cloud Base/Ceiling
- Cloud Types
- Precipitation (not IR)
- Fog
- Convective Cloud Prob.
- ASOS
- LWP/ IWP

Many of these use multiple sensors and/or new information or techniques not used in the fundamental product generation

Even though no forecaster may want to see cloud particle size in AWIPS, our ability to make accurate estimates of particle size is necessary for the derived products. For example, both Icing and Precipitation use cloud phase, optical depth, cloud-top temperature and cloud particle size.



Current and Planned Use of JPSS Cloud Products by NWS

- VIIRS cloud detection and cloud-top pressure are used in creation of the CrIS Radiance fields for NCEP Radiance Assimilation.
- VIIRS Cloud-top pressure are used in the NESDIS Polar Winds which is assimilated by NWP centers.
- NOAA/OAR/ESRL has requested cloud-top temperature (primary) and other fields from SNPP and NOAA-20 over the Arctic for assimilation into the HRRR.
- Fog / Low Stratus (M. Pavolonis) and SkyCover (J. Gerth) are widely used by NWS.
- Other cloud products are available in AWIPS but use is unclear.
- CSPP does (CLAVR-x) and will (SAPF) provide these level2 products to the DB community.